ACCOUNT OF NONLOCAL IONIZATION AND SLOW ELECTRON ENERGY BALANCE IN GLOW DISCHARGE MODELS

Eliseev S.I.[1], Bogdanov E.A.[1], Kudryavtsev A.A.[1]

[1]*St. Petersburg State University, Ulyanovskaya, 3, St. Petersburg, Russia,* *step.eliseev@yandex.ru*

Numerical simulation of cathode region of DC glow dischargeis a serious challenge due to complex kinetic behavior of electrons, the most important being non-local ionization by fast electrons which stream from cathode sheath. Applicability of different simulation approaches –extended fluid, particle/kinetic, hybrid –towards numerical modelling of direct-current (DC) glow discharges and their ability to correctly describe non-local ionization has been discussed intensively during last decades [1,2]. Simple hybrid approach seems to be the most promising in terms of accuracy and computational efficiency, since it combines fluid description for ions and slow electrons with analytical formulation of non-local ionization source [3].

We present overview and details of simple hybrid approachin appliance with DC glow discharge simulations together with formulation of slow electron energy balance. Electrons originating from non-local ionization by fast electrons contribute significantly to the energy balance of slow electrons in negative glow plasma. This heating process has to be accounted for if accurate estimations of electron density and electron temperature in plasma region of discharge are required. An approach towards calculating effective energy brought by a secondary electron to the group of slow electrons by means of coulomb collisions is suggested. The value of effective energy shows considerable dependence on external parameters of a discharge, such as gas pressure, type and geometric parameters.

The slow electron energy balance was implemented into simple hybrid model and allowed calculating electron density and electron temperature. Simulations of short (without positive column) DC glow discharge in argon were carried out for a range of gas pressures. Comparison with experimental data showed good agreement in terms of current-voltage characteristics, electron density and electron temperature.

REFERENCES

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